

# ECE 440 - Introduction to Computer Networks

Spring 2019

# HTTP connections

## *non-persistent HTTP*

- at most one object sent over TCP connection
  - connection then closed
- downloading multiple objects required multiple connections

## *persistent HTTP*

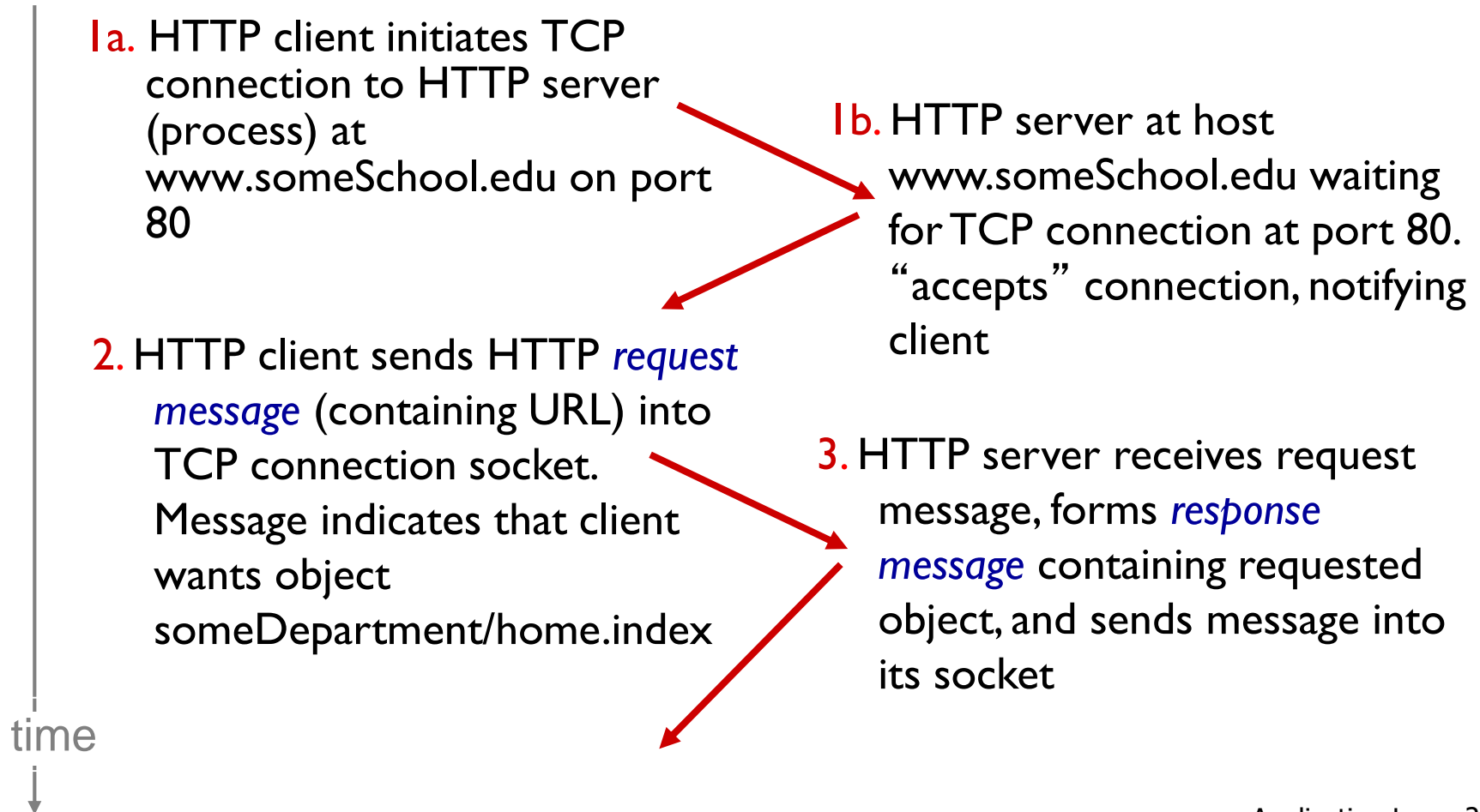
- multiple objects can be sent over single TCP connection between client, server

# Non-persistent HTTP

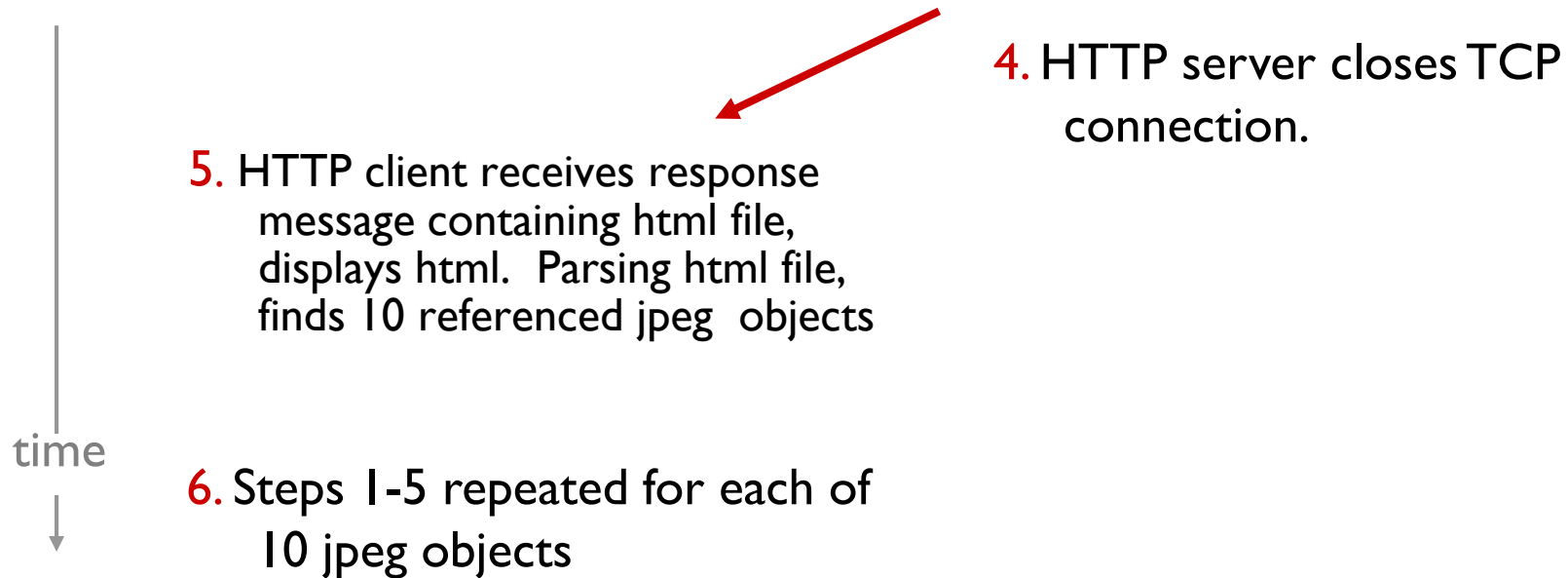
suppose user enters URL:

`www.someSchool.edu/someDepartment/home.index`

(contains text,  
references to 10  
jpeg images)



# Non-persistent HTTP (cont.)

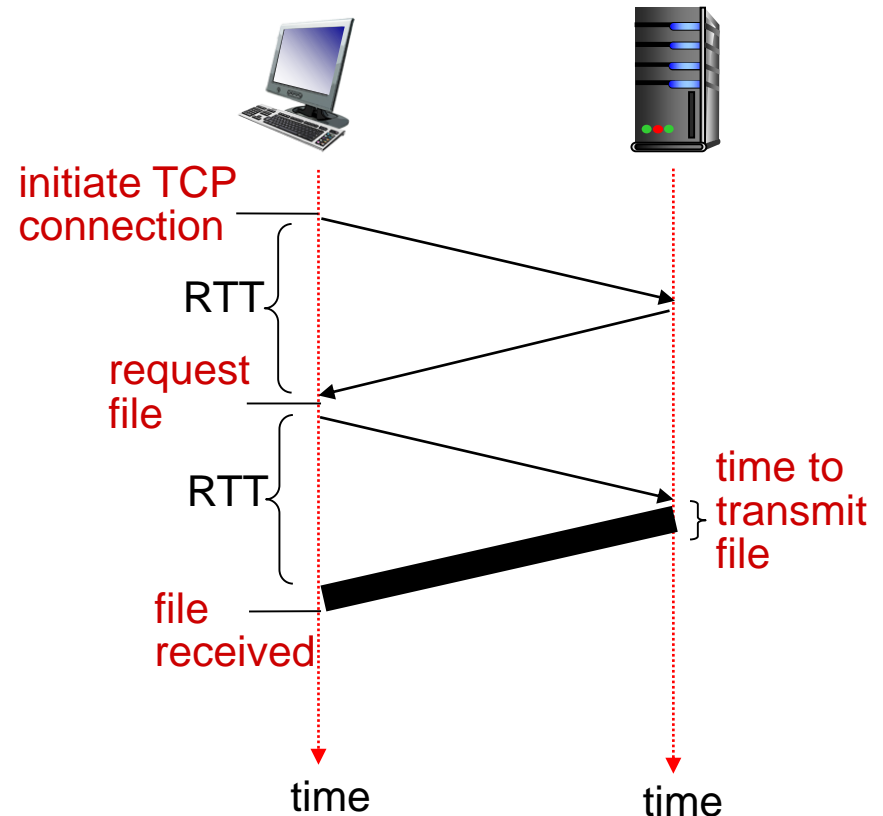


# Non-persistent HTTP: response time

**RTT (definition):** time for a small packet to travel from client to server and back

**HTTP response time:**

- one RTT to initiate TCP connection
- one RTT for HTTP request and first few bytes of HTTP response to return
- file transmission time
- non-persistent HTTP response time =  
 $2\text{RTT} + \text{file transmission time}$



# Persistent HTTP

## *non-persistent HTTP issues:*

- requires 2 RTTs per object
- OS overhead for *each* TCP connection
- browsers often open parallel TCP connections to fetch referenced objects

## *persistent HTTP:*

- server leaves connection open after sending response
- subsequent HTTP messages between same client/server sent over open connection
- client sends requests as soon as it encounters a referenced object
- as little as one RTT for all the referenced objects

# HTTP request message

- two types of HTTP messages: *request, response*
- **HTTP request message:**
  - ASCII (human-readable format)

request line  
(GET, POST,  
HEAD commands)

header  
lines

carriage return,  
line feed at start  
of line indicates  
end of header lines

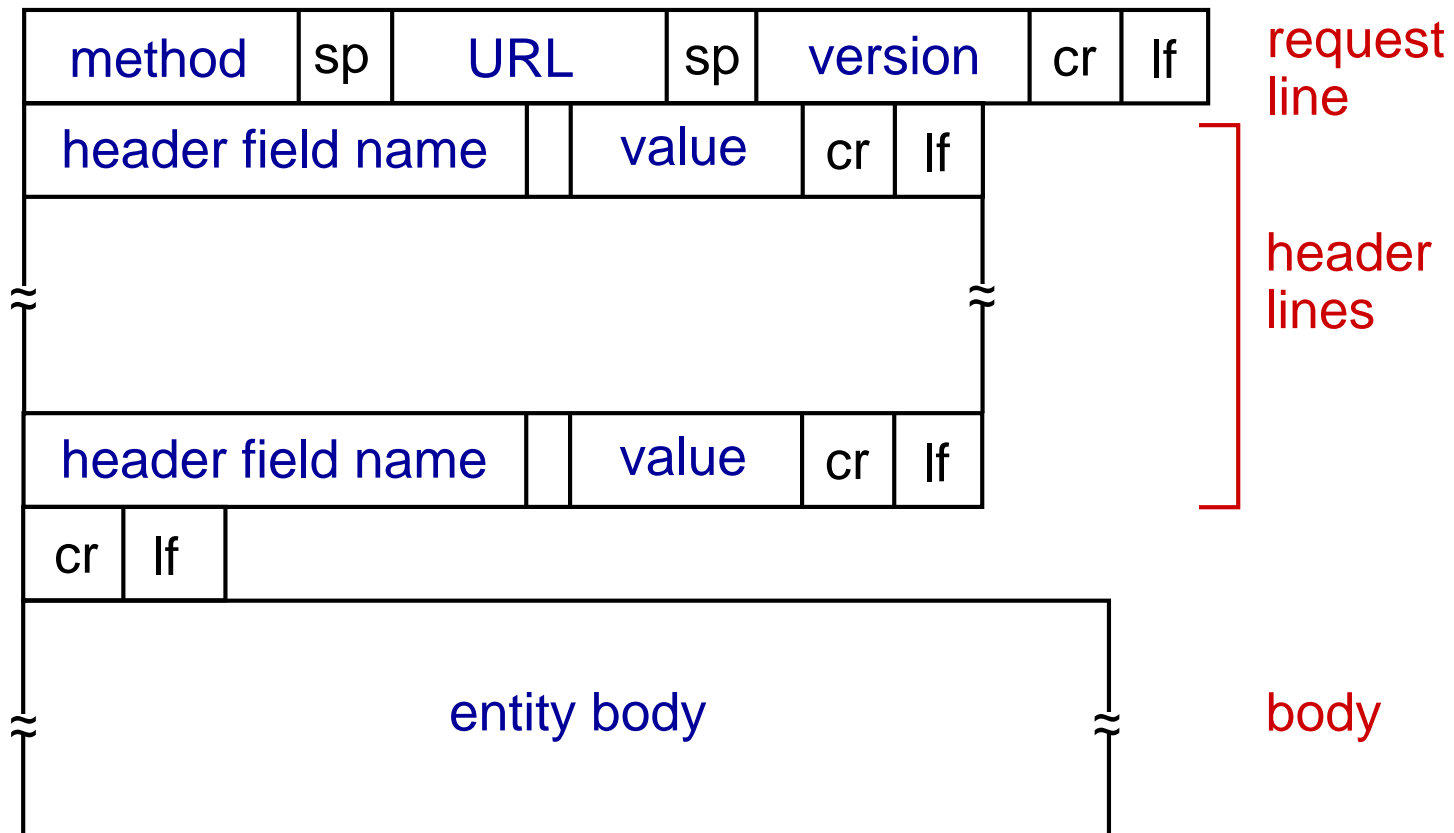
```
GET /index.html HTTP/1.1\r\n
Host: www-net.cs.umass.edu\r\n
User-Agent: Firefox/3.6.10\r\n
Accept: text/html,application/xhtml+xml\r\n
Accept-Language: en-us,en;q=0.5\r\n
Accept-Encoding: gzip,deflate\r\n
Accept-Charset: ISO-8859-1,utf-8;q=0.7\r\n
Keep-Alive: 115\r\n
Connection: keep-alive\r\n
\r\n
```

carriage return character

line-feed character

The diagram illustrates the structure of an HTTP request message. It shows a sequence of lines: a request line, followed by multiple header lines, and ending with a blank line. Blue arrows point from descriptive text labels to specific parts of the message. One arrow points from 'request line (GET, POST, HEAD commands)' to the first line. Another arrow points from 'header lines' to the block of header lines. A third arrow points from 'carriage return, line feed at start of line indicates end of header lines' to the blank line. Two arrows at the top right point to the '\r\n' sequences at the end of the first and second lines, labeled 'carriage return character' and 'line-feed character' respectively.

# HTTP request message: general format





# Uploading form input

## POST method:

- web page often includes form input
- input is uploaded to server in entity body

## URL method:

- uses GET method
- input is uploaded in URL field of request line:

`www.somesite.com/animalsearch?monkeys&banana`

# Method types

## HTTP/1.0:

- GET
- POST
- HEAD
  - asks server to leave requested object out of response

## HTTP/1.1:

- GET, POST, HEAD
- PUT
  - uploads file in entity body to path specified in URL field
- DELETE
  - deletes file specified in the URL field

# HTTP response message

status line

(protocol

status code

status phrase)

header  
lines

data, e.g.,  
requested  
HTML file

```
HTTP/1.1 200 OK\r\n
Date: Sun, 26 Sep 2010 20:09:20 GMT\r\n
Server: Apache/2.0.52 (CentOS)\r\n
Last-Modified: Tue, 30 Oct 2007 17:00:02
      GMT\r\n
ETag: "17dc6-a5c-bf716880"\r\n
Accept-Ranges: bytes\r\n
Content-Length: 2652\r\n
Keep-Alive: timeout=10, max=100\r\n
Connection: Keep-Alive\r\n
Content-Type: text/html; charset=ISO-8859-
      1\r\n
\r\n
data data data data data ...
```

\* Check out the online interactive exercises for more  
examples: [http://gaia.cs.umass.edu/kurose\\_ross/interactive/](http://gaia.cs.umass.edu/kurose_ross/interactive/)

# HTTP response status codes

- status code appears in 1st line in server-to-client response message.
- some sample codes:

## **200 OK**

- request succeeded, requested object later in this msg

## **301 Moved Permanently**

- requested object moved, new location specified later in this msg (Location:)

## **400 Bad Request**

- request msg not understood by server

## **404 Not Found**

- requested document not found on this server

## **505 HTTP Version Not Supported**

# Trying out HTTP (client side) for yourself

1. Telnet to your favorite Web server:

`telnet gaia.cs.umass.edu 80` { opens TCP connection to port 80  
(default HTTP server port)  
at gaia.cs.umass.edu.  
anything typed in will be sent  
to port 80 at gaia.cs.umass.edu

2. type in a GET HTTP request:

`GET /kurose_ross/interactive/index.php HTTP/1.1`  
`Host: gaia.cs.umass.edu` { by typing this in (hit carriage  
return twice), you send  
this minimal (but complete)  
GET request to HTTP server

3. look at response message sent by HTTP server!  
(or use Wireshark to look at captured HTTP request/response)

# User-server state: cookies

many Web sites use cookies

*four components:*

- 1) cookie header line of HTTP *response* message
- 2) cookie header line in next HTTP *request* message
- 3) cookie file kept on user's host, managed by user's browser
- 4) back-end database at Web site

*example:*

- Susan always access Internet from PC
- visits specific e-commerce site for first time
- when initial HTTP requests arrives at site, site creates:
  - unique ID
  - entry in backend database for ID

# Cookies: keeping “state” (cont.)

client



server



cookie file



ebay 8734  
amazon 1678

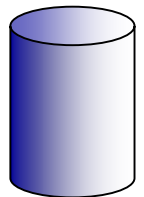
usual http request msg

Amazon server  
creates ID  
1678 for user

usual http response  
**set-cookie: 1678**

create  
entry

backend  
database



usual http request msg  
**cookie: 1678**

cookie-  
specific  
action

access

usual http response msg

access

cookie-  
specific  
action

one week later:



ebay 8734  
amazon 1678

usual http request msg  
**cookie: 1678**

usual http response msg

# Cookies (continued)

*what cookies can be used for:*

- authorization
- shopping carts
- recommendations
- user session state (Web e-mail)

aside

*cookies and privacy:*

- cookies permit sites to learn a lot about you
- you may supply name and e-mail to sites

*how to keep “state”:*

- protocol endpoints: maintain state at sender/receiver over multiple transactions
- cookies: http messages carry state



# Web caches (proxy server)

**goal:** satisfy client request without involving origin server

- user sets browser: Web accesses via cache
- browser sends all HTTP requests to cache
  - object in cache: cache returns object
  - else cache requests object from origin server, then returns object to client

